

Technical Report 924

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Initial User Assessment of the Operations Planning Tools (OPT)

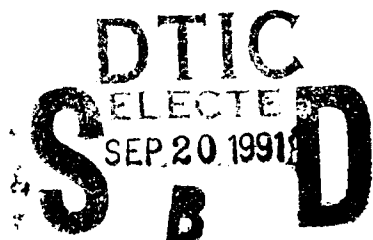
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U.S. Army Research Institute

April 1991



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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report describes assessment of a decision aid called the Operations Planning Tools (OPT). OPT resides on the Tactical Planning Workstation. The assessment was conducted using a division-level offensive scenario set in the Federal Republic of Germany. Two experienced combat arms officers used OPT to develop and analyze tactical courses of action to perform the 3-day assessment. This document describes the assessment procedure and user feedback on the design and features of OPT. User reaction to the concept and applications of OPT was favorable, and recommendations for future enhancements were identified.						
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Initial User Assessment of the Operations Planning Tools (OPT)

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Operational Effectiveness

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FOREWORD

This document contains the findings of user assessment of the Operations Planning Tool (OPT), a decision aid for assisting combat staffs in evaluating tactical courses of action (COA). Operations Planning Tools (OPT) was developed in the human performance command and control laboratory of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Fort Leavenworth Field Unit. OPT provides automated support for developing, analyzing, selecting, and justifying a tactical COA and enhances the planner's war-gaming capabilities by providing timely battlefield-outcome measures that allow a comparison of alternative COAs. With OPT, the user has the flexibility to perform "what if" analyses using either a "quick and dirty" approach or a more detailed analysis. Two operations officers experienced in command and control used a division-echelon tactical exercise to conduct the assessment.

This assessment was conducted as part of ARI research task 1304, Enhancing Command Staff Performance in Combat Operations. The work was performed in accordance with the Memorandum of Agreement between the Combined Arms Combat Development Activity and ARI on "Development and Implementation of the Future Battle Laboratory," dated 30 June 1989. The results of this assessment were presented to the Command and Control Integration Council, Combined Arms Command, in July 1990. The findings will be used by combat developers in decisions that involve identification of automated support aids that can be integrated into existing and planned automated command and control systems.


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INITIAL USER ASSESSMENT OF THE OPERATIONS PLANNING TOOLS (OPT)

EXECUTIVE SUMMARY

Requirement:

The objective of this research was to determine the potential utility of the Operations Planning Tools (OPT) for enhancing information processing and tactical planning from prospective users.

Procedure:

Two experienced observer-controllers from the Battle Command Training Program (BCTP) served as surrogate staff planners in a two-phase evaluation. During Phase I (without OPT), the team developed, analyzed, war-gamed, and recommended a tactical course of action (COA) using procedures of their choice. This phase provided a baseline for identifying the procedures they used for tactical decision making and planning. Post-exercise interviews were used to identify perceived deficiencies in manual planning and to obtain recommendations for enhancing the manual process. During Phase II, tactical decision making and planning was supported by OPT. OPT provided capabilities for battlefield visualization, resource synchronization, task organization, combat power calculations, time-distance calculations, and projected attrition. Post-exercise interviews were used to obtain feedback on user acceptance, ease of use, potential utility, timeliness of OPT operations, perceived quality of OPT support, flexibility of support provided by OPT, and recommendations for enhancements.

Findings:

During Phase I, participants were observed and reported themselves to have difficulty with visualizing the battlefield, war gaming, developing alternative COAs, correlating enemy and friendly forces, and performing detailed analyses. These difficulties were attributed to time constraints during the planning process and to the complexity of the task processes and procedures. Participants reported that OPT supported more extensive war-gaming and provided the flexibility to do "what if" analyses in a timely and more detailed manner than planning without OPT.

Utilization of Findings:

The information will be used to alert the combat developments community to the capabilities of OPT and to obtain additional feedback on potential use and enhancements. The findings will be used as a basis to integrate OPT characteristics and features into emerging tactical command and control systems.

INITIAL USER ASSESSMENT OF THE OPERATIONS PLANNING TOOLS (OPT)

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INITIAL USER ASSESSMENT OF THE OPERATIONS PLANNING TOOLS (OPT)

INTRODUCTION

Purpose

The Fort Leavenworth Field Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has developed the Experimental Development, Demonstration, and Integration Center (EDDIC) to conduct research in human performance aspects of command and control. The EDDIC equipment and facilities have been used to investigate issues related to the use of automation to enhance tactical planning by an operations staff officer at the division echelon. The Tactical Planning Workstation is an integral part of the EDDIC environment (Flanagan & Fallesen, 1990; Packard, 1990). The Workstation, along with tools it contains, provides a surrogate system to examine automated capabilities to support tactical planners in required information processing and decision making functions.

Operations Planning Tools (OPT) is the most recent addition to the Workstation. In this assessment, the OPT and Workstation were used by two participants who played the role of operations staff officers during a tactical planning exercise. The participants, whose knowledge and experience are representative of potential OPT users, provided opinions, comments, and recommendations for supporting tactical planning and decision making. This information from potential users will provide feedback to designers and developers for improvements and expansion of the OPT design.

Report Organization

The remainder of the introduction presents a brief overview of the current OPT concept and functional capabilities, a statement of evaluation objectives and the general approach used to address these objectives. The second section presents the evaluation method, and the third section presents the results of post-exercise interviews with participants. Conclusions and participant recommendations are presented in the final section.

OPT Overview

OPT was developed during the evolutionary development of the Tactical Planning Workstation. The concepts for the Workstation and OPT came from requirements analysis based on projected needs of tactical planners, constraints of how they typically perform their functions, capabilities of computers to provide assistance, and resource constraints. The cognitive

requirements of the task and the style of typical performance were taken into account. Some of the characteristics of the task situation which impacted the design of OPT include:

- Time pressures of the situation.
- Variability in what procedures are used in planning.
- Tendency to not consider a breadth of options in much detail.
- Difficulty in the ability to visualize time and space relationships.

These characteristics involving the task, the situation, and limitations in human performance indicate that the level of deliberate analysis that should go into producing tactical plans is often not accomplished. Although improvements in training and procedures provide potential partial remedies, computer support is a logical solution as well (McKeown, Fallesen, Perkins & Ross, in preparation).

Through careful consideration of computer support capabilities, functional support criteria were defined for augmenting the cognitive limitations. Three areas of functional support were identified: presentation support, computational support, and organizational support. The presentation support was aimed at aiding visualization. OPT displays the current situation and tactical courses of action. Information is displayed on the terrain, battlefield control measures, unit types, strengths, locations, and dispositions. A timeline feature is available to help relate time and space of battle events. Computational support is provided for aiding the making of quantitative estimates. Estimates of movement distance, time, combat power ratios, and attrition are supported by OPT. Organizational support is provided for aiding information management. Since elements of the tactical situation and courses of action are encoded in the computer in an organized way, OPT can process this information quickly to revise and test modifications in a rapid manner.

OPT-user interaction criteria were also specified in the design (McKeown et al.). These criteria were identified from experience in computer-user interaction, task constraints, and goals. The criteria included

- To have the tool provide support that is adaptable to variable planning procedures (e.g., detailed vs general).
- To have the users retain control of the planning process.

- To minimize the user workload that would be created by use of the tool.
- To have tools that are understandable and that produce familiar products by familiar methods.
- To improve planning performance (speed, thoroughness, accuracy, certainty, and product quality).

Table 1 provides a list of features indicating how OPT supports the development and evaluation of courses of action.

Table 1

User-support Features and Functions of OPT (from McKeown et al.)

OPT supports the user in doing the following:

Creating a COA using either the current situation database or previously created COAs.

Naming COAs and routes.

Entering a route start time.

Assigning missions for friendly and enemy forces.

Designating start and end points of a route and segments of a route.

Choosing the level of detail for analysis (number of routes, number of segments per route).

Inserting, deleting, or modifying start and end locations for a route or segment.

Recording narrative or descriptive information for segments, routes, and COA.

Selecting friendly and enemy units involved in segments.

Assigning mission roles (e.g., close combat) while arraying friendly and enemy forces on the map display.

Displaying raw (i.e., baseline and default) combat power (CP) for a unit.

Modifying planning factors for movement.

Modifying travel time (e.g., add a delay factor) in a segment based on factors not considered in the time calculation algorithm.

Modifying mission related CP values to account for force multipliers not considered in the attrition algorithm.

Repositioning friendly and enemy units on the display.

Highlighting units displayed on the map for a segment.

Viewing a timeline of mission assignments for individual friendly and enemy units throughout a COA.

Adjusting attrition rates.

OPT does the following:

Calculates and displays distance travelled by user-designated units on a route or segment.

Calculates and displays time required on user designated units to travel on a route or segment (based on trafficability of terrain, mission type, and CPR).

Calculates and displays the proportion of distance that is go, slow-go, and no-go on a route or segment (based on cross-country mobility data).

Calculates and displays CP and relative combat power (RCP) for friendly and enemy forces performing designated missions for a segment.

Estimates friendly and enemy attrition for a segment, route, and COA (based on factors related to mission type, CPR, and unit role)

Calculates and displays summary data for projected battle outcome measures for a particular COA.

Calculates and displays summary data (e.g., attrition) for projected battle outcome measures to allow comparison of COAs.

Displays a timeline legend with day-night indications for visualizing the relative positioning of units on multiple routes during a COA.

Repositions units assigned to the route for subsequent segments.

Assessment Approach

The general approach was to allow two participants, who represented potential operations staff officers, to utilize a demonstration version of OPT and the Workstation for tactical planning and decision making¹. A two-man team played the role of operations staff officers for a division echelon offensive scenario specially developed for evaluation and experimental purposes. Participants used OPT to support the development of alternative COAs for a tactical scenario and then to decide upon and to justify the preferred COA. As part of the evaluation, users also had to plan and make decisions using traditional techniques without automated support (i.e., manual planning). Manual planning, which was conducted before automated support planning, provided information on how the participants currently plan and make decisions without the aid of automation. This information was used by the participants as a point of reference (i.e., baseline) to make personal comparative judgments to assess the potential benefits of OPT features and capabilities. This understanding along with their recognition of certain problems associated with manual planning process formed the foundation for their suggestions, comments, and recommendations for improvements and enhancements in OPT design.

Assessment Objectives

Observation of user performance during planning (manually and with OPT) and the information obtained during post exercise interviews was used to address the following major concerns:

- Does the user understand and accept how OPT works?
- Does OPT enhance the capability of the user to visualize time and space relationships of the battlefield?
- Does OPT support the information processing and cognitive processes of the decision maker and planner?
- Does OPT provide the user with timely, accurate, and thorough results and support?
- Will use of OPT support the development of higher quality products than developed in manual planning?

¹ The general approach for the user evaluation is similar to that used for evaluation of the AirLand Battle Management (ALBM) System. This was a joint evaluation conducted by the U.S. Army Research Institute, the Communications-Electronics Command, and the Future Battle Laboratory 12-16 March, 1990 and 30 April-4 May, 1990. Procedures were documented in guides entitled ALBM Operational Users Evaluation.

- Can OPT be used in a flexible manner to support the varied needs of the user and yet ensure that the user is aware of process steps that can or should be followed during tactical decision making?
- Can OPT be utilized in the development, analysis, war-gaming, and comparison of COA?
- Can OPT be integrated into the current organizational structure of command and control?
- Do the map and graphic display capabilities of OPT (and the tactical planning workstation) support the users' needs?
- Does OPT enhance the capability of the user to present the results and products?
- What features of OPT do users utilize and like most?
- What features of OPT need to be either eliminated or modified, or what features should be added?

METHOD

Participants

The two participants were observer-controller personnel from the Battle Command Training Program (BCTP). Both participants were combat arms officers (see Table 2). One participant was a graduate of the Command and General Staff College (CGSC). Both participants had advanced educational degrees.

The two participants organized themselves essentially into operations and intelligence functions. Based on their operational experiences, one participant focused on friendly forces (operations) and the other on opposing forces (intel). To identify their responses, the labels "Participant Op" and "Participant Intel" are used.

Table 2.

OPT User Assessment Participant Characteristics

<u>Participant</u>	<u>Rank</u>	<u>Branch</u>	<u>Staff Experience</u>	<u>Education</u>
Op	LTC	Infantry	Brigade S3 Division G3	MMAS CGSOC MS (Math)
Intel	MAJ	Infantry	Battalion S2 Battalion S3 Brigade S3	MA (Pol.Sci.) CGSOC selectee

Equipment and Facilities

The experiment was conducted in the main laboratory of the Experimental Development, Demonstration, and Integration Center (EDDIC), a research facility of the ARI Field Unit at Fort Leavenworth, Kansas. There were differences in the configuration of the supporting facilities for the treatment conditions (see Figures 1 and 2); however, the following capabilities of the facility supported data collection for all experimental conditions. Two video cameras were permanently mounted on the side walls of the main laboratory. These cameras were remotely controlled from the observation room to pan and zoom about the laboratory, and video and audio recordings were made on video cassette recorders located in the observation room. These video cameras also provided input to monitors in the observation room. Audio input to the recorders was accomplished from both fixed

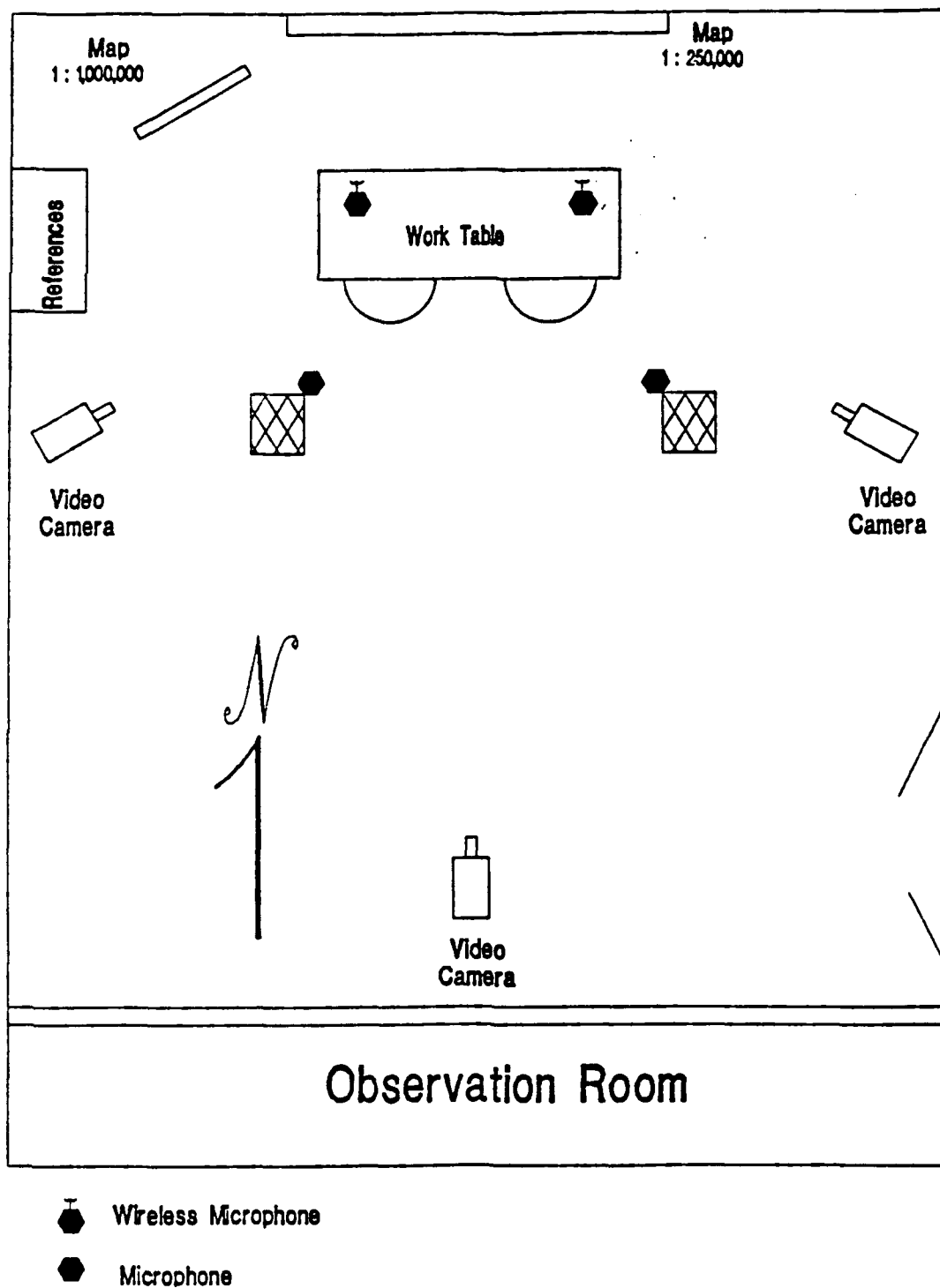


Figure 1. Configuration for the Manual Planning Exercise

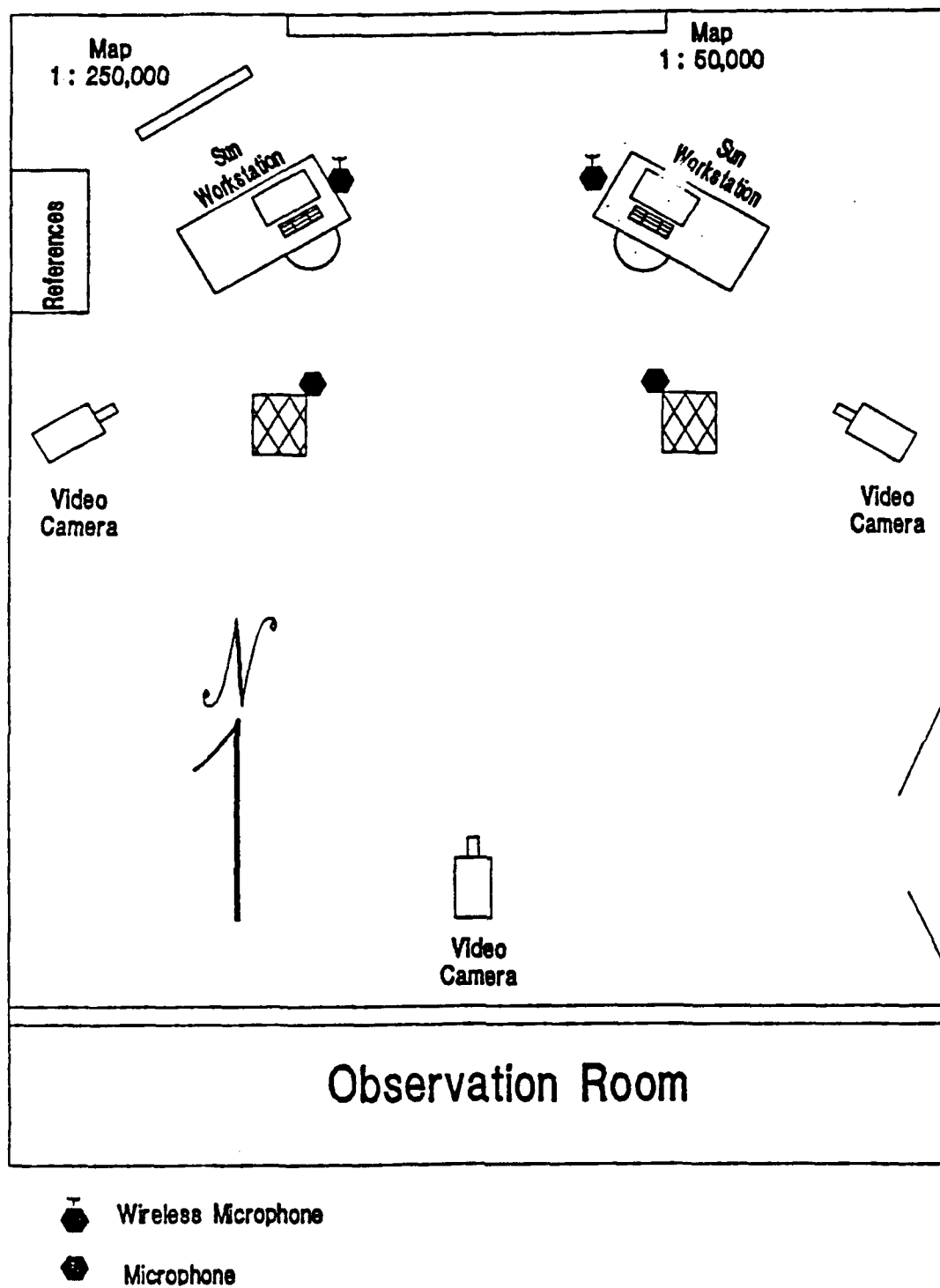


Figure 2. Configuration for the Exercise with OPT Support

microphones in the laboratory and wireless microphones mounted on each participant. The latter microphones ensured the best fidelity of the audio track on the video tape. A third video camera (with microphone) was tripod-mounted in the south end of the main laboratory. This camera backed up the fixed cameras and also provided recording of exercise time plus a direct view of exercise activities at the north end of the main laboratory. This third camera had an automatic focus; however, it did not have a pan capability.

Figures 1 and 2 illustrate the configuration for the observation room during the Manual Planning and OPT Supported exercises, respectively. Direct observation of all exercises was performed by experimenter personnel. They were located in an observation room at the south end or rear of the laboratory was. One-way windows provided unobtrusive observations of participants by data collectors. Direct communication between experimenter personnel in the observation room and an exercise moderator in the main laboratory was maintained by the use of a two-way radio communication system. Communications on this system were not recorded except manually in a moderator's log in the laboratory. The moderator was present in the laboratory for exercise control and assistance.

As described previously (Flanagan and Fallesen; Packard) the Tactical Planning Workstation was a Sun 3/160C Color Sunstation (Sun Microsystems, Inc.). The Workstation includes a color, high resolution 19-inch display (1152 X 900 pixels). The Workstation was programmed in Ada and C languages, and a UNIX operating system was used. All interface with the Workstation is achieved using the keyboard or a three-button mouse pointing device. Two Workstations were available for use, and they were netted in a local area network (LAN).

At the front of the room was a large scale tactical map with overlay (1:250,000 or 1:50,000 for manual or OPT exercises, respectively). A small scale map was positioned off to the side of this map (1:1,000,000 or 1:250,000 for manual or OPT exercises, respectively). Reference materials were located on a table at the side of the exercise room.

Procedures

Overview

The procedures followed the format used for the ALBM Users Evaluation (see footnote 1). The evaluation consisted of two major phases. The first phase required participants to develop, analyze, war-game, and recommend a COA for a corps level defensive scenario using manual procedures of their choosing, without OPT. Following this, participants performed a division echelon offensive scenario (Fallesen, Michel, and Carter, 1989) using OPT. The following describes the procedures for the two phases of the evaluation.

Manual Exercise

Agenda and participant activities. Participants began the evaluation by completing a demographic questionnaire to obtain information on training and experience relevant to the current evaluation. Critical information obtained included institution training background, prior unit assignments and experience, and prior knowledge of and experience with computers.

A prebriefing was then conducted to inform users on the purpose and nature of the evaluation, the types of data that would be collected, and how the data would be utilized. Participants were then asked to review, understand, and sign an informed consent to participate in the exercise.

The exercise began with a delivery of an operations briefing by the force commander. The corps level defensive scenario was taken directly from the TRADOC Common Teaching Scenario (TCTS). The situation was set in the Fulda Gap area of the Federal Republic of Germany (FRG). Hostilities had not yet broken out, and the 10th U.S. Corps G-3 Plans Division was developing contingency OPLANS. Basic planning guidance required the participants to effectively use all available Corps resources to counter a major thrust by the enemy 8th Combined Arms Army. As a minimum, planning was directed to consider a covering force battle and the defense of the main battle area. Primary emphasis was on operations and intelligence play with minimal information provided on personnel and logistics area. Participants were required to review all materials, develop feasible courses of action, analyze and war-game COAs, and select and justify a recommended COA to be briefed to the force commander.

Post-exercise interview. The participants were interviewed together on the afternoon after the manual planning exercise. Questions were addressed to both participants, and each was allowed to respond when and how he desired. The interview was

separated into two segments dealing with (a) a description of the general process and procedures used to develop the plan briefed to the corps commander, and (b) a detailed discussion of manual planning activities and associated problems. The interviewing process and information collected during the interview was used to address the following objectives:

- A. Describe the process and procedures used by participants to conduct manual planning and decision making
- B. Insure that participants understood the process that was used for planning and decision making
- C. Obtain subjective data from users on problems related to manual planning and decision making
- D. Obtain user opinions on improvements in planning and decision making processes that could be achieved through automation.

Description of manual planning. Following the manual exercise, evaluators had a coordination meeting to construct a model of the process used by the participants during manual planning (objective A from above). This model, in the form of a flow diagram, was presented to the users during the first segment of the interview. The following summarizes the types of comments made by and questions asked by the evaluators.

- 1. Copies of the flow diagram were given to each of the participants. The evaluator then gave the following instructions: "Based on what we observed during the exercise, we feel that you used this process. Take your time and look at the process that we recorded. We will then talk about the process to determine if there is anything that we may have missed, or if there is anything you might have liked to have done differently".
- 2. After participants had reviewed the process, the following questions were asked.

Is this a good description of what you did during the exercise?

If NO then:

How would you describe it differently?

What did you do that we didn't observe?

When and where in the process did you do it?

3. Once the description of the process has been refined to the participants' satisfaction, the following questions were asked:

If you were to do this type of exercise again, would you do anything differently?

What? And where in the process?

If you had more time, would you have done anything differently?

This segment of the interview allowed evaluators to refine and finalize a description of the process and procedures used by participants to conduct manual planning (objective A). As a result of interactions between evaluators and participants, all had a clear understanding of the process that was used for manual planning (objective B) and developed a process model.

Information on manual planning. In the process of discussing the manual planning process, the interview provided the participants' perspective on potential problems with manual planning (see objective C). As problem areas became more evident to the participants, they were more prepared to recognize improvements that could be implemented with particular features and capabilities inherent in OPT. Information collected during this phase, along with products developed by the participants, also allowed evaluators to more clearly determine if the planning process and products were doctrinally sound. Using the flow diagram as a stimulus to refresh their memory of the planning activities that were used, participants were asked questions related to gathering facts and making assumptions; arraying the forces; developing, analyzing, and comparing COA; and briefing the commander.

OPT Exercise

OPT training. OPT is intended for division level G3 planners as a highly flexible decision support aid used in conjunction with existing capabilities of the Tactical Planning Workstation. In order to prepare participants to use OPT and the Workstation, a four-hour period of instruction was scheduled. Training was a hands-on practical exercise whereby participants operated the system based on guidance provided by instructors. The use of two systems and two instructors (one for each participant) maximized training benefits of the session. A defensive scenario was used for instructional purposes.

Tactical scenario and participant activities. The exercise began with delivery of the force commander's guidance. The division level offensive scenario was generally based on the TCTS. It was developed in 1986 and based on "J" series TO&Es. The scenario is set in the Fulda Gap area of the FRG. Hostilities were underway for several weeks, and the 16th Mechanized Infantry Division (MID) had been conducting offensive operations for the last week against the 10th Combined Arms Army in an effort to restore the Inter-German Border (IGB). A 10th U.S. Corps frag order had just been received ordering the 16th MID to attack in 16 hours to seize terrain along the IGB. The 16th MID had a proportional slice of 10th U.S. Corps resources consistent with their mission of conducting the corps supporting attack. Primary emphasis was on operations and intelligence information; however, selected personnel and logistics data were also provided. Participants were required to review available material, develop COAs, perform analyses and war-gaming, and select and justify a recommended course of action (Fallesen, Michel & Carter, 1989).

Training familiarized participants with the Workstation and OPT capabilities; however, it was recognized that only four hours of training might not make participants proficient and independent users of the system. In order to compensate for a lack of proficiency in system use, an interactor was provided to assist participants during the actual exercise. Ideally, the goal was to have participants use the system without assistance; however, it was predicted that the interactor would assist participants even though they performed a significant proportion of the system related activities.

Post-exercise interview. Questions asked during the interview were developed based on the OPT assessment objectives. Questions were grouped in categories of gathering facts and visualizing the battlefield, developing routes and segments, and arraying the forces. Very generally, each question addressed at least one of the following qualitative criteria:

Transparency: Does the user have a basic understanding of how OPT works?

Acceptance: Does the user accept OPT operating capabilities and capabilities?

Utility: Would OPT-like features be used in a field environment?

Ease of use: Is OPT easy to use?

Timeliness: Does OPT provide timely support of planning activities?

Accuracy & quality: Does OPT support the development of higher quality products relative to manual planning?

Flexibility: Does OPT provide flexible support to the planner?

RESULTS

Overview of the Manual Exercise

The manual exercise was conducted as a straightforward operations planning exercise. No guidance was given to participants regarding the steps or procedures to be followed in their planning effort. With minimum reference to available staff planning guides (primarily ST 100-9), the team organized themselves, established a schedule to culminate in a briefing to the commander, and proceeded to develop and analyze alternative courses of action. The time allocated for the exercise was tight; however, the team rapidly and efficiently completed the exercise in the time allotted, including the briefing to the corps commander. In the course of the exercise, observers documented in flow diagram form the planning process actually used, the time needed to perform major tasks, and the products generated.

Manual Exercise Questions and Comments

Copies of the flow diagram were given to each of the participants (see Figure 3). The numbered questions which were asked follow with the response in **bold type**.

1. Is this a good description of what you did during the exercise?

Yes.

2. If you were to do this type of exercise again, would you do anything differently? What? And where in the process?

They would not do anything differently. They stated they had used the procedures and processes described in ST 100-9 and FM 101-5.

3. If you had more time, would you have done anything differently?

More effort would be spent on correlation of forces, more COAs would have been developed, more thorough war-gaming would have been conducted to include critical events, and generally the analysis would have been in more detail. In general, they felt that a cursory analysis was conducted. Analysis focused at the regimental level, and they did not consider specific combat power comparisons resulting from counting of tubes, BMPs, etc. They used very general rules for war-gaming (e.g., a brigade can defeat a regiment when a 3:1 ratio of forces exists).

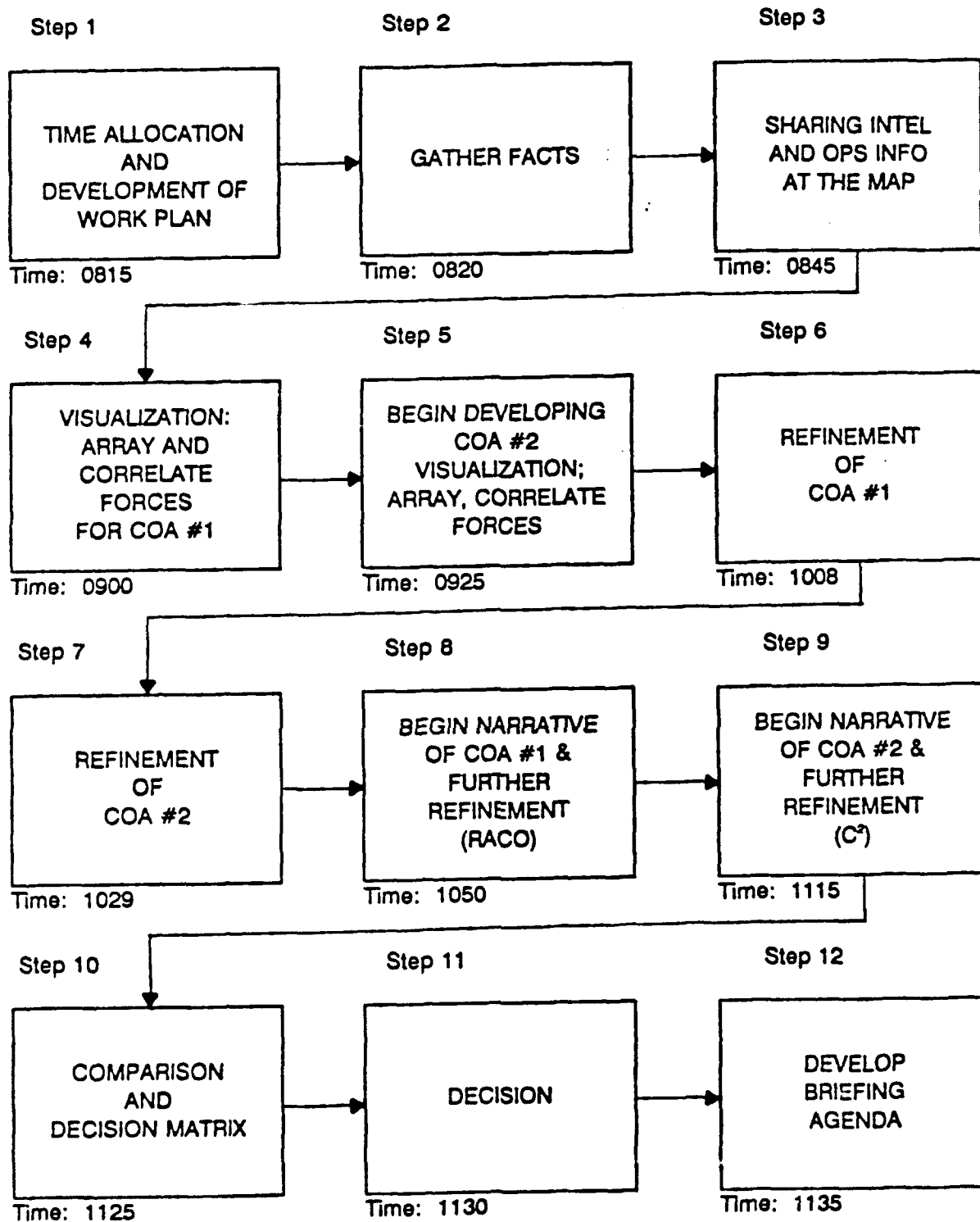


Figure 3. Mental model used by participants during manual planning.

Other relevant comments were made regarding standardization for calculating combat power and the use of quantitative approaches to war-gaming. It was stated that there is no U.S. Army standard for evaluating combat power and that it could vary from division to division and corps to corps. This can lead to inconsistent estimates of the situations across similar units and between the various echelons involved in combat; and thereby, adversely impact on planning effectiveness. For example, two divisions using different techniques within the same corps would be competing for the corps resources based on unstandardized means for projecting resource requirements.

One participant questioned the utility of an approach that appears to use the "Soviet model" for war-gaming. The numbers associated with combat power are considered to be subjective. Systems (like MCS) that make criteria-based decisions do not necessarily convince the planner of the recommended decision; the system may speed up the process, but it does not necessarily influence the decision. Overall, it was felt that conducting a correlation of forces is necessary but that the technique for doing it is unclear.

4. What were the key facts that you identified?

Participant Op focused on the friendly mission, constraints, and force availability. Participant Intel focused on the enemy situation, the area of operation, and climatology.

5. Did you make a record of these facts as you did your planning?

Key information was indicated in the "fact books" by use of highlighting. Both participants also made notes of critical facts.

6. Did you make any assumptions? What assumptions did you make?

Assumptions were made but not necessarily stated or recorded. Example assumptions were that friendly units would have time to occupy their defensive positions, corps units would have time to occupy their positions so that the flanks would be covered, admin and log could support the effort, and that the positions of enemy forces represented ground truth.

7. Did you record these assumptions while planning?

No.

8. If you had a choice, would you rather remember the critical information and assumptions--or would you rather have a way to quickly look it up as you needed the information?

They would rather have access to the information. Participant Intel would normally keep a notebook that was organized with tabs to facilitate information management. Planning assumptions and other information are normally filed for fast and easy access. Participant Op normally keeps a list of tasks to use as a checklist as COA are developed. This checklist included information required by higher echelons.

9. Did you have any problems arraying the forces? How easy was it?

No problems. They looked at the forces along the area of operations and arrayed friendly units against them.

10. Is there anything that would make it easier for you to array the forces?

There was some disagreement on the types of tools that would make arraying the forces easier. Participant Intel wanted a tool with a high level of automation; more analytical and predictive capabilities were desired. He wanted a system that used both the doctrinal template and situational templates to conduct a correlation of forces to allow predictions of factors to include the axis that would most likely be the "main strike".

Participant Op did not feel that current technology supported the goals suggested by the other participant. He wanted a system that relied more on the judgment of the human to make the decision. Speed and ease of use are critical characteristics of a system that allows the analyst to do the work.

Participant Intel questioned the capabilities of most staff members to be effective analysts. He felt analysts are often not sufficiently trained; when this occurs, the best training is in the field but this happens too infrequently. He felt that staff members in the field can array the forces; however, analytical skills are lacking and decisions are more frequently made on judgment and emotion.

11. Did you array the forces in what you considered to be a timely manner?

Participants felt that the initial array was done in a timely manner with no problems.

12. Did you consider combat power when you arrayed the forces?

Yes. Brigade (BLUE) versus division (RED) equivalent comparisons were made. Precise estimates were not made. Participants said it would be desirable to know information like percentage strength as part of war-gaming.

13. As you were arraying the forces, how easy was it to visualize the disposition of friendly and enemy forces on the battlefield?

It was not difficult for the initial array; however, it was more difficult when movement was considered. Visualization of movement was difficult.

A side comment by both participants indicated that planners must assume that units are the "same" in terms of intangible factors like leadership, training, and morale.. Planning must be at the generic level and this consideration is not echelon dependent.

14. Any ideas of how to improve your capability to visualize the battlefield when you are arraying the forces?

We need to have a better way to work with movement. For example, we need to be able to visualize movement in columns when friendly forces are not fighting. It would be nice to know how long it will take to move from point A to point B. and the separation between units.

15. How did you go about developing your first COA? Did you work from the current situation and visualize the battle starting at that point?

They first determined how the enemy was arrayed and the most likely location of the enemy's main strike. The commander's intent was considered as they drew a mental picture of the battlefield framework. They ensured that the frontline had enough resources, but there was also concern with other portions of the battlefield beside the close battle--like the deep battle.

16. Do you think you considered all the major alternative COAs?

No. There were probably many more, to include arraying of the covering force. Time was the limiting factor.

17. Did you predict battle outcomes in your development of the COA?

Outcomes were considered at a very high level. For example, predictions were made on whether or not regiment-size units would be defeated. The need for reconstitution was also considered.

18. Were there any battle outcome measures you would like to use, but did not (in developing your COA)?

Yes. One was how long it would take to reconstitute units after a reduction in strength. It would be nice to know the increase in strength over time at the corps level and down to brigade. We need a tool that will give present changes in numbers and types of equipment and people as they move in an assembly area.

19. What is the difference between visualizing and war-gaming?

Participant Intel said they are done independently. War-gaming considers movement, attrition (BLUE and RED), and the timeline. Visualization considers more of maneuver and movement.

Participant Op felt that visualization and war-gaming were done simultaneously. Visualization is taking the commander's intent and drawing a picture--drawing the commander's vision (of the battlefield). You see what he sees. War-gaming is how the enemy is arrayed. The commander has to war-game to develop the intent; he has to consider attrition and movement.

20. How confident are you in your estimates of attrition?

They felt that the estimates were within two standard deviations of what actual attrition would be. They also indicated that they "fall back" on the numbers in ST 100-9, such as those given for the length of time to do a mission.

21. Would you have liked to have considered more measures or battle outcomes in developing and selecting your COA?

It (war-gaming) is an art. Many staff officers in field are not aware and do not know the contents of ST 100-9. They have no idea of some of the steps (in the estimate of the situation). Participant Intel said the manual is not distributed as doctrine; and it should be distributed. It is a useful tool.

22. When did you finish war-gaming?

Up to the decision. Their minds may have been made up before doing the decision matrix. They were still war-gaming while doing the matrix, but a decision had already been made.

23. If the matrix had not supported your decision, what would you have done?

Had to change the numbers, particularly if the boss wanted numbers. You can not quantify gut feelings. War-gaming is very subjective. Weights are often justified by factors relevant to the commander's intent.

24. Was there sufficient time to prepare for the briefing?

No. They would need more time to generate the quality of product required by some commanders in the field.

25. Do you have enough time in the field?

It depends on the boss. In one case, Participant Intel said it took up to 5 hours to prepare for a 3 hour briefing. Many commanders are micro-managers. Another commander may want only the basics. One hour preparation may be enough.

26. What tools could help you prepare for the briefing?

Simple graphics capabilities were desired to turn planning materials into transparencies. No tool will probably help with phase lines; a high quality product is required. In general, a light pen--or some other device--may be helpful for drawing. The computer should have a menu that allows creation of slide formats for different types of briefings; all briefings do not have the same purpose.

27. Would you like a printer?

One participant said that one former boss liked to have a notebook. All information needed to be printed and reduced for his notebook. In this form it could be transmitted by FAX. Paper increases the capability to transmit. A terminal could be used, but not everyone has one.

Overview of the OPT Exercise

The actual conduct of the OPT exercise was modified from what was planned because of intermittent software problems. These began on the first day (during training) so it was necessary to modify how scenario and reference data were presented to participants. Instead of using the Workstation to provide the information required to gather facts and develop assumptions, indexed notebooks were provided to participants to perform these activities. When the participants were ready to use OPT, it was still performing unsatisfactorily, and the interactor operated the system under the guidance of the participants. While this arrangement precluded a thorough assessment of interface issues, the concept of OPT and its perceived impact was still able to be evaluated to a limited extent. System problems also imposed time constraints on the exercise; consequently, it was necessary to eliminate the requirement to prepare and conduct a briefing for the force commander on the selection and justification of a course of action. To compensate for the elimination of the briefing, participants were asked to comment on how OPT might have been used in the conduct of a command briefing.

OPT Exercise Questions and Comments

1. Did you have any problems reading the map displays?

Participant Op said he needed to get familiar with computer generated maps; he is not comfortable with them. Using the printed map is better because it provides a full perspective. The computer was OK for war-gaming. Participant Intel thought that the map scales should be standard military scales. He also said it was hard to see cities; they were labelled but not represented on the null background.

Related observations:

The only map backgrounds used by the participants were the cross country mobility (CCM) maps and the null background. Both participants made significant use of marker pens and overlays on the paper map. Participant Intel marked key terrain features, and Participant Op marked control measures like axis, engagement areas, and intermediate objectives.

2. What could you visualize better with the computer maps and what could you visualize better with paper maps?

Participant Intel felt that a line-of-sight perspective for the maps was needed. There were no perceived benefits of a flat map. From an intelligence perspective, it is helpful to be able

to look down an avenue; a 3-dimensional perspective provides a better feel of the terrain contour.

Related observations:

Participants did not have the time or opportunities to use the elevation banding and shaded-relief backgrounds which would provide enhanced visualization of contour, but not necessarily of a 3-dimensional perspective.

3. How easy or difficult was it to develop segments and routes using OPT?

It was simple.

4. Is using segments and routes to develop a COA similar to the way you normally go about developing a COA?

Participant Intel said he had reviewed ST 100-9 and concluded that OPT did not prompt the user on the steps required to perform the estimate of the situation. By not doing this, there is an assumption that the user knows the process, but users in the field often do not know the process. If you do not perform certain steps of the process you can come up with the wrong answers. Even though it was recognized that ST 100-9 is literally not Army doctrine, he felt that the Army does have a standard. He felt it is important to follow the model, and if we do not, it is not clear why we have one (the schools's position is that it is useful for training, but not optimal for execution). It was recognized that the user may elect not to do all steps or to choose to alter the steps. Without the model, the user may not follow a logical process, and the quality of decision making will be affected. It was recommended that the system should prompt you if a step is not performed, and the system should tell you what to do in that case.

Participant Intel also pointed out that intelligence analysts often leave out significant steps of the analytical process. People have trouble analyzing situations, and they need assistance from the tool.

Participant Op had different beliefs. He wants a tool like OPT to help the user do war-gaming. This is a weakness in the current process, and the tool can add depth and detail in the analysis to provide projections on measures like time and losses. OPT was considered to be moving in the right direction; he did not feel that embedding a process model was necessary.

5. Why was development of the COA done on the map boards?

Participant Op said that he was more comfortable with paper maps; maps on screens are not just the same. Maps are tightly packed on an 8 by 12 picture, and he does not have a warm and fuzzy feeling about using them. It is possible that an officer who started using computer generated maps early in his career, like in an officer basic course, would be more comfortable with them.

Related observation:

Both participants were noted to cover large sections of the map board in relatively short periods of time. With map scales typically used during the exercise (and during EDDIC experiments) (1:80,000 and 1:160,000), the area of the map displayed was significantly smaller than the size that participants viewed in a matter of seconds or less on the paper.

6. Was arraying the forces easier on the map or with OPT?

Arraying the forces and war-gaming were said to be easier on OPT because you could follow the force structure throughout the COA.

Related observation:

Friendly forces that were arrayed were identified using the map board and recorded on butcher paper; so, technically, the initial array of friendly forces was done without OPT.

7. What about correlation of forces?

Participant Intel said that using the computer was faster than moving "stickers" on the map board.

A follow-on question asked: Do you feel that you clearly understood how to assign missions as either close combat, support, or reserve?

Participant Op said he understood how they were defined and classified. He was not sure of any other way to define or classify unit roles. When further asked if more roles should be defined, Participant Op said he could think of none.

8. What echelons are appropriate for development (and analysis) of COA?

Two levels below and one up.

9. Did you agree with the types of battle outcomes that were presented by OPT (combat power losses, movement duration, movement distance, and unit strength)?

They were sufficient. Also they would have liked percentage of strength following losses -- as opposed to loss of combat power points.

10. Did you feel comfortable with the actual values of the war-gaming measures presented by OPT?

OPT projections for movement duration for the first segment of COA1 (29 hours) was similar to their projection (24 hours). According to the participants, OPT seemed to use the same rules of thumb as they did, but they wanted to be able to adjust these values based on experience.

Related observations:

Participants did not directly comment on their acceptance or non-acceptance of combat power losses; however, at no time during the exercise did they show any reactions or make comments that suggest a disagreement with the combat power loss projections made by OPT.

11. Did you feel that battle outcome (war-gaming) measures were generated in a timely manner?

Yes.

12. If additional factors were integrated into the war-gaming measures generated during a segment, how long would you be willing to wait for the types of outcomes presented by OPT?

Participant Op said he would wait a maximum of 5 to 10 seconds; and that 10 seconds can seem like 10 minutes in the field (It was obvious that he felt strongly about his response). Participant Intel would be willing to wait up to 1 minute.

13. When arraying the forces, would you rather see the raw combat power for each unit or the mission-related combat power as determined by OPT?

Both participants agreed that they would rather use the mission combat power used by OPT.

14. Do you think a user should be given the opportunity to adjust the combat powers?

Participant Op was not comfortable with having or using adjustments for a "bunch of K (intangible) factors." Participant Intel expressed concern on where you stop in consideration of factors. The factors should be assigned values up front for those factors where you have proof for making the adjustment.

15. Did use of OPT affect the quality of war-gaming?

Participant Op said yes; it provided additional time to consider "what if" situations. This gave additional time (to do a more thorough analysis). Participant Intel agreed with these statements.

Related observations:

On several occasions during the exercise, Participant Op conducted a "what if" analysis as a result of considering the outcome of the OPT war-gaming.

16. How did you go about developing the COA?

It was done very roughly at first by specifying the COA. They were then refined in an incremental fashion.

Related observations:

Participants added more and more detail and considered more factors and situations in the war-gaming throughout the exercise. After the COA were initially specified, participants would consider excursions (what if situations) as a result of the OPT war-gaming outcomes for specific segments.

17. Do you think you considered all the major alternative COAs?

No. Did not consider a COA with a main attack in the north.

Related observation:

The Division Commander's guidance specified a division axis of advance for the assigned tactical mission. The division axis

of advance was on the southern portion of the zone of operations. The participants apparently misinterpreted this to mean the Commander desired the main attack of the Division to be in the south, and they then sought alternative supporting attacks as a basis for developing alternative courses of action.

18. Generally speaking, how flexible was OPT in allowing you to develop alternative COAs?

It allows "what if" war-gaming and provided flexibility. A somewhat unrelated comment by Participant Intel suggested that the term "child" should be replaced with a term of greater military relevance like "branches and sequels."

19. How easy or difficult was it to keep track of the various COAs?

Participant Op said it was a little difficult at times. After a follow-up question, he stated that use of the narrative feature of OPT might have helped as well as use of more meaningful names for the COA names, instead of COA 1 and COA 2.

20. Overall, if you had an OPT-like system in the field would you use it?

Probably would be useful.

21. Did you use the OPT battle outcome measures in your COA comparison? What other measures would you like?

Participant Op said that OPT had the ones (measures) he looks for (movement duration, combat power, distance). The matrix format for presenting information provided easy access. No other measures were requested.

22. What impact did OPT have? What other factors were considered?

Participant Intel said he could live with the results and it made the decision easier. Participant Op considered combat outcomes to be the most critical factors; he also felt the OPT G2 and G3 factors are more important in the model and that G1 and G4 factors could be dealt with after G2 and G3 factors were perfected.

23. How easy or difficult was it to keep track of the tables--segment summary, force array, raw combat power, COA comparison summary--displayed by OPT?

Participant Op felt that the user would learn how to position the tables on the screen as he became more familiar with OPT; he also liked the capability of OPT that allowed him "to do it my way."

Participant Intel did not feel it was necessary to go to a two screen workstation. Another comment indicated that he preferred a mouse with only one button.

24. Overall, do you feel that the use of OPT made you more or less confident in the recommendation you made for the COA?

Participant Op indicated that it made him more confident, because he had a number to go to. It was obtained easily, and it is something that can be shown to the boss. He would say that doctrine was used to generate the numbers, and the commander would have to decide what to do with it. He felt as confident with OPT's numbers as compared to doing the analysis by pencil.

25. Did you feel that you were in control using OPT?

Participant Op said yes. He wants a tool that does not throw the human out of the loop. This is critical because there is too much uncertainty on the battlefield, creating situations that are difficult to program in the computer.

Participant Intel said he wanted "a machine that does it for me". One that would predict outcomes and make it easier to say that "I agree (or disagree) with it". "The tool (OPT) dragged me to the answer"--he wanted more automation. An example of this is ASAS. He wants a systems that provides a 90% solution--that is good enough. That is better than what an S2 can do in the field.

26. What element and personnel of the command and control structure do you think would use OPT?

The Plans Cell of the Division-Main TOC would be the primary user. Other G3 Plans Cells that could use it would be the Division-Rear and the Corps Plans, G3. Participant Intel did not want a machine that would tie the senior Plans officer to it because this officer would be involved with many other things (e.g., using communications), so, a specialist or sergeant would be the one actually at the terminal. Participant Op felt that a captain in the Plans Cell would be the primary tool user.

27. What special skills and knowledge do you think users would need before they are trained on OPT?

Participant Op felt the major prerequisite skills and knowledge was an understanding of the "big picture." Experience in the "art of war" is the critical factor and not previous knowledge and experience with hardware and software systems (note that for Participant Op, a captain is the primary user who interfaces with the system).

Participant Intel felt that OPT was simple enough. With training in its use, no specialized skills would be required.

28. What training challenges would you anticipate if OPT was fielded?

Participant Op felt that training would be conducted primarily in Operations and Intelligence School, CAS3, and in CGSC during the early stages of fielding for the equipment, and that a key part of training is learning the "art of war".

Participant Intel felt that training challenges could arise if personnel who were not intended to be users are put in a situation to use the system. The Tactical Computer Terminal (TCT) of the Maneuver Control System (MCS) was cited as an example. It was broken a lot by infantry and communications personnel who were not trained to use it.

29. Would you project any changes in organizational structure and staffing if OPT was integrated into the TOC?

Participant Op felt there would be no TO&E changes, but that teaching would have to be part of CAS3 (Combined Arms Services Staff School, and other related courses) so that there would be a clear understanding of roles and responsibilities.

Participant Intel feels that staff versus combat skills creates a problem, particularly for the infantry. There are two possible organization approaches--one requiring a special military occupational speciality (MOS) (or a skill identifier for an existing MOS) and the other requiring no specialized MOS or skill identifier. Creating an MOS or skill identifier is not considered a good solution because new positions would probably be taken "out of hide". Without a specialized MOS, then the strategy would require familiarization training at the institutional level and on-the-job-training at the unit level.

30. What about the need for a printer?

Participant Intel pointed out that not everyone is likely to have access to a screen (computer display) and that certain printouts may be good to have. He suggested that there is a need to have a capability to print a field of the screen in a timely manner.

31. What type of briefing support capabilities would you like?

Participant Op thought that output would be helpful to show timelines, combat power results by time, and other specialized applications. He felt maps and overlays will probably always be done as they have been in the past.

Participant Intel said that multimedia presentation is now done by a USAREUR commander. The screen has replaced viewgraphs. In general, at the division level, the computer is good because it can show the big picture. For brigade and below, there seems to be a greater comfort factor with a paper map. Participant Intel felt that a computerized display should show the flow of the battle to include the decision points for committing forces. The system should be able to show the "7 minute battle"² with attrition displayed over time; this type of system may "do away with the map".

32. Are there any general comments?

Participant Op said he was "glad that someone is looking in depth at the war-gaming process" and that "a device like this, even in a rudimentary form, puts us ahead of where we are today". Participant Intel expressed the need to have system terminology that is consistent with current Army usages. For example, "segments" could be called "phases" and a "child" could be called a "branch". When assigning BLUE and RED missions, there needs to be a meeting engagement (i.e., attack versus attack) option.

²The "7 minute battle" or "7 minute war" is a technique used at the National Training Center and in the Battle Command Training Program to review a battle or operation in 7 minutes.

DISCUSSION

The results from the manual and OPT exercises and associated interviews indicated that the two participants felt there was a valid need for supporting course of action analysis and that OPT provided useful support.

The manual exercise allowed an opportunity for the participants to think about needs for improving planning performance. In the corps scenario, they developed two courses of action in a little over an hour. They continued to refine and document them for another hour and a quarter. They felt that with more time in the manual exercise they would have done more thorough correlation of forces, more courses of action, more thorough and detailed war-gaming, and more analytical combat power comparisons. They used a general unit equivalence method of correlation of forces. They felt that the battle outcome projections that they made were at a general level of detail, mostly considering whether the attacking regiments would be defeated. They recognized that a more detailed analysis would be required by many commanders. They suggested that it would be useful to include projections of how long it would take to reconstitute units and what the change in strength might be from corps through brigade levels. They recognized that a tool will not convince a planner of a recommended decision, but that it could speed up the process.

The two participants differed in how much support that a system or tool should provide. Participant Intel thought staff members are often questionable analysts. He thought a tool should do as much of the analysis and guiding of a standard procedure as it could. The Op Participant indicated that war-gaming is a subjective process that cannot be completely quantified. He felt that a tool should support human judgment, not replace it.

The overall results from the assessment are described for each assessment issue.

Issue: Does the user understand and accept how OPT works?

The participants reported that OPT was simple and easy to learn and use. Their answers implied that the design goal to keep the human in the loop was met. They accepted how OPT worked and felt that it provided good support to war-gaming -- a function highly in need of support. One participant reported that he would like to use OPT in the field for war-gaming.

Issue: Does OPT enhance the capability of the user to visualize time and space relationships of the battlefield?

The participants responses to interview questions prior to knowing anything about OPT indicated that they wanted a tool to help estimate movement times and distance between units. They reported that it was "Very useful to see force array down the entire route of the attack." and "The tool helped us visualize the outcomes of actions by the enemy in depth and our own reaction."

Issue: Does OPT support the information processing and cognitive processes of the decision maker and planner?

The participants felt that the support provided to war-gaming and "what if" analysis was very beneficial. They thought OPT was easy to use for designating movement routes and arraying forces. They reported that OPT helped make the decision an easier process.

Issue: Does OPT provide the user with timely, credible, and thorough results and support?

An unplanned comparison of time estimations was available. When OPT was temporarily unavailable, the participants continued planning and estimated that a particular movement would take 24 hours. OPT's calculation of the movement time for the same event turned out to be 29 hours, which was within the participants' expectations. They felt that the OPT results were very timely. They made no negative comments and had no negative reactions to any of the attrition results. They reported that arraying forces would be easier on OPT and faster than moving stick-on unit symbols on a paper map. One of the participants said that 'OPT led us to a solution that we could live with.'

The participants agreed with the OPT design that tracking losses at the personnel and equipment level would be too detailed and that it was not needed. Also they agreed with the OPT feature that allows factors to be adjusted by wartime experience.

Issue: Will use of OPT support the development of higher quality products relative to manual planning?

The participants agreed that OPT enhanced their result by allowing them to do more "what ifs" and giving them time to consider more factors.

Issue: Can OPT be used in a flexible manner to support the

varied needs of the user and yet ensure that the user is aware of process steps that can or should be followed?

Participant Op felt that OPT did support the task appropriately in a flexible manner. He felt that the focus on war-gaming and "what if" analysis was good to allow this flexibility. Participant Intel did not believe that flexibility (in how the task is performed) is appropriate, implying that tools should be designed for the "standard model" given in ST 100-9. His perception of the planning process as a structured, stepwise process differed from Participant OP, ARI observations, and the OPT designers.

Issue: Can OPT be used in the development, analysis, war-gaming, and comparison of COAs?

Again the participants felt that OPT was good for analysis, war-gaming and comparison of COAs. The speed of the computer helps to support these tasks.

Issue: Can OPT be integrated into the organizational structure of command and control?

The participants felt that OPT would be useful at Division Main - Plans, Division Rear - Plans, Corps Main - Plans, and Brigade tactical operations center. They envisioned no significant changes to tables of organization and equipment (TO&E). Typical operators were projected to be either operations non-commissioned officers or captains in the plans cell. Participant Intel thought that it would be best to have a military occupational speciality (MOS) associated with the operation of OPT.

Issue: Do the map and graphic display capabilities of OPT (and the Tactical Planning Workstation) support the user's needs?

The OPT maps and graphics were reported to be alright for wargaming, but the participants were uncomfortable with computer-generated maps for situation assessment and concept development. They felt that the screen area was too small to see the full perspective. One of them reported difficulties seeing the representation of cities. Of the various map types available they used the cross-country mobility map nearly exclusively. They acknowledged that working with the computer-generated maps may be something that one would have to work with and become familiar with over time.

Issue: Does OPT enhance the capability of the user to present

the results and products?

The participants thought that products might be presented to the commander on view-graphs or print-outs rather than the computer display. They felt that graphical charts may be preferable over the results tables for these presentations. They did report that the timeline displays of forces and associated battle outcomes would be helpful.

Issue: What features of OPT do users utilize and like most?

OPT's war-gaming capabilities were most liked based on the frequency and nature of the participants comments. They saw the rapid generation of branches and sequels as being very useful for "what if" analysis. The timeline feature was also mentioned as being very useful in synchronizing the battle.

Issue: What features of OPT need to be eliminated or modified, or what new features should be added?

The participants felt that any added battle results should be available in 5-10 seconds and anything over a minute would be totally unacceptable. They had some difficulty keeping the different courses of action separated using only the generic "COA 1" and "COA 2." They thought that selected OPT terminology needs to be reviewed. Also they asked for the following features or capabilities be added:

- The projected time needed for reconstituting units.
- 3-D map perspectives.
- Display of force losses as percentage of total force strength.
- Hard copy printer.
- An administrative move calculator tool for units behind the FLOT (forward line of own troops).

In addition to these issues, they saw potential in OPT for training to show how to do the war-gaming process. They were adamant that war-gaming is the biggest deficiency in the way planning is currently done. Participant Op provided an excellent summary of the OPT development and the importance of this users' assessment:

"I think you are on track here. I am glad to see someone looking in depth at the war-gaming process. We are, in my judgment, sorely lacking in that

because it is hard to do; it is time consuming. It takes a group of people to come together to do it, and, as a result, we are blowing it off in the field and ignoring it. I really think that a device like this, even in a rudimentary form, will put us ahead of where we are right now."

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